
CLAIMS

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(57) [Claim(s)]
[Claim 1] The 1st compressor (1) by which capacity adjustment is carried out with an inverter (15) at predetermined capacity adjustment within the limits at two or more steps, It has the 2nd compressor (2) in which capacity adjustment is carried out by the unload device (2a) at two or more steps with a larger and step size smaller than the above-mentioned capacity adjustable range of this 1st compressor (1) than the step size of the 1st compressor (1) of the above. A target capacity operation means to be the compressor capacity control unit of the freezer which controlled the sum total capacity of these both compressors (1) and (2) on the multistage story, and to calculate the sum total target capacity (L1) of the above-mentioned compressor (1) and (2) (50), The output of this target capacity operation means (50) is undergone. In the capacity of the phase near sum total target capacity (L1) The above-mentioned compressor (1), It has the control means (51) which controls the above-mentioned inverter (15) and an unload device (2a) to adjust the sum total capacity of (2). This control means (51) In the time of increase of the sum total target capacity (L1) calculated with the above-mentioned target capacity operation means (50) When the capacity of the 1st compressor (1) is the following near the maximum, sequential increase only of the capacity of the 1st compressor (1) is carried out. Both compressors (1), When sum total target capacity (L1) increases further after it adjusted the sum total capacity of (2) to sum total target capacity (L1) and the capacity of the 1st compressor (1) rose [the capacity of the 2nd compressor (2)] to near the maximum in the condition of under maximum Only one step increases the capacity of the 2nd compressor (2), and only the capacity of the part which subtracted the capacity for one step of the 1st compressor (1) from the capacity for one step of the 2nd compressor (2) decreases the capacity of the 1st compressor (1). Both compressors (1), While adjusting the sum total capacity of (2) to sum total target capacity (L1), it sets at the time of reduction of sum total target capacity (L1). When the capacity of the 1st compressor (1) has exceeded near the minimum value, sequential reduction only of the capacity of the 1st compressor (1) is carried out. Both compressors (1), The sum total capacity of (2) is adjusted to sum total target capacity (L1). Both compressors (1), When sum total target capacity (L1) decreases further after the capacity of the 1st compressor (1) fell to near the minimum value in the condition that (2) is driving Only one step decreases the capacity of the 2nd compressor (2), and only the capacity of the part which subtracted the capacity for one step of the 1st compressor (1) from the capacity for one step of the 2nd compressor (2) increases the capacity of the 1st compressor (1). Both compressors (1), The compressor capacity control unit of the freezer characterized by adjusting the sum total capacity of (2) to sum total target capacity (L1).

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
(Field of the Invention)
This invention relates to the preventive measures of a fall of the endurance which originates in a frequent capacity change of a compressor especially about the compressor capacity control unit of a freezer.
(Prior art)
Conventionally, as a compressor capacity control unit of this kind of freezer, in the air conditioner, have the compressor by which capacity adjustment is carried out with an inverter, carry out increase and decrease of the capacity of this compressor of control with an inverter according to change of an indoor air-conditioning load etc., air-conditioning capacity is made to correspond to an air-conditioning load good, and what performs indoor comfortable air-conditioning is known so that it may be indicated by JP,59-56649,A etc.
(Object of the Invention)
By the way, if the change number of stages of the capacity is set as a multistage story when carrying out increase and decrease of the capacity of a compressor of control, refrigerating capacity can be responded good with a frozen load, improvement in the frozen engine performance can be aimed at, and it is desirable.
It is possible to adjust the sum total capacity of a compressor to a multistage story comparatively, as a low price is also, and to aim at improvement in the frozen engine performance there by carrying out the displacement control of the compressor of another side by the unload device, and controlling the sum total capacity of both the compressor device to target capacity value mostly, while preparing two sets of compressors and carrying out the displacement control of one compressor with an inverter.
When carrying out a deer and adjusting the sum total capacity of a compressor to a multistage story in this way, one compressor is comparatively fine at an inverter, for example, capacity adjustment is carried out 10% at a unit, and capacity adjustment of the compressor of another side is made 50% and 100% comparatively greatly by the unload device. For this reason, adjustment control of the sum total capacity of a compressor setting up basic capacity value with the compressor for example, by the side of an unload device, carrying out adjustment control of the capacity almost equal to the capacity difference of that basic capacity value and target capacity value with the compressor by the side of an inverter, and adjusting the sum total capacity of a compressor to target capacity value is performed.
However, when target capacity value changes in that case according to change of a frozen load etc. (for example, when target capacity value carries out both-way fluctuation between 40% and 50%), the compressor by the side of an unload device repeats and carries out the start and stop of actuation and the halt by the capacity between 0% and 50%, therefore the endurance of this compressor falls, and the fault which causes the fall of the dependability arises.
This invention is made in view of this point. The purpose When carrying out the displacement control of two sets of the compressors by the inverter and the unload device respectively like the above, increase and decrease of the sum total capacity of two sets of compressors of adjustment are carried out maintaining the capacity condition of the compressor by the side of an unload device for a long time as much as possible. It is shown in being able to adjust refrigerating capacity to a multistage story and aiming at improvement in the frozen engine performance, lessening the start-and-stop frequency of the compressor by the side of an unload device as much as possible, and aiming at improvement in the endurance by making it converge on target capacity value good.
(The means for solving a technical problem)
In order to attain the above-mentioned purpose, the concrete solution means of this invention The 1st compressor (1) by which capacity adjustment is carried out with an inverter (15) at predetermined capacity

adjustment within the limits at two or more steps as shown in Fig. 1 , It has the 2nd compressor (2) in which capacity adjustment is carried out by the unload device (2a) at two or more steps with a larger and step size smaller than the above-mentioned capacity adjustable range of this 1st compressor (1) than the step size of the 1st compressor (1) of the above. It is premised on the compressor capacity control unit of the freezer which controlled the sum total capacity of these both compressors (1) and (2) on the multistage story. And the control means (51) which controls the above-mentioned inverter (15) and an unload device (2a) to adjust the sum total capacity of the above-mentioned compressor (1), and (2) to the capacity of the phase near sum total target capacity (L1) is made to have in response to the output of a target capacity operation means (50) calculate the sum total target capacity (L1) of the above-mentioned compressor (1) and (2), and this target capacity operation means (50). Moreover, it sets at the time of increase of the sum total target capacity (L1) calculated with the above-mentioned target capacity operation means (50). When the capacity of the 1st compressor (1) is the following near the maximum, sequential increase only of the capacity of the 1st compressor (1) is carried out. Both compressors (1), When sum total target capacity (L1) increases further after it adjusted the sum total capacity of (2) to sum total target capacity (L1) and the capacity of the 1st compressor (1) rose [the capacity of the 2nd compressor (2)] to near the maximum in the condition of under maximum Only one step increases the capacity of the 2nd compressor (2), and only the capacity of the part which subtracted the capacity for one step of the 1st compressor (1) from the capacity for one step of the 2nd compressor (2) decreases the capacity of the 1st compressor (1). Both compressors (1), While adjusting the sum total capacity of (2) to sum total target capacity (L1), it sets at the time of reduction of sum total target capacity (L1). When the capacity of the 1st compressor (1) has exceeded near the minimum value, sequential reduction only of the capacity of the 1st compressor (1) is carried out. Both compressors (1), The sum total capacity of (2) is adjusted to sum total target capacity (L1). Both compressors (1), When sum total target capacity (L1) decreases further after the capacity of the 1st compressor (1) fell to near the minimum value in the condition that (2) is driving Only one step decreases the capacity of the 2nd compressor (2), and only the capacity of the part which subtracted the capacity for one step of the 1st compressor (1) from the capacity for one step of the 2nd compressor (2) increases the capacity of the 1st compressor (1). Both compressors (1), It considered as a configuration which adjusts the sum total capacity of (2) to sum total target capacity (L1).

(Operation)

By the above configuration, by this invention, if the sum total target capacity (L1) of a compressor (1) and (2) calculates with a target capacity operation means (50) at the time of frozen operation While the displacement control of the 1st compressor (1) is carried out by the control means (51) with an inverter (15) Since the displacement control of the 2nd compressor (2) is carried out by the control means (51) by the unload device (2a) Also when the above-mentioned sum total target capacity (L1) is finely set as a multistage story, coincidence adjustment of the sum total capacity of both compressors (1) and (2) is carried out mostly at the above-mentioned target capacity (L1), and improvement in the frozen engine performance is achieved.

In that case, the capacity of the 2nd compressor (2) by the side of an unload device (2a) Since increase change is not carried out unless the capacity of the 1st compressor (1) by the side of an inverter (15) becomes 100% near the maximum For example, in changing sum total target capacity (L1) between 50% and 60%, only the capacity of the 1st compressor (1) changes between 50% and 60%, and the capacity of the 2nd compressor (2) holds 0% (idle state). And after the capacity of the 1st compressor (1) becomes 100% when sum total target capacity (L1) increases from 100% to 110% that is, [for example,] While the capacity of the 2nd compressor (2) is adjusted to 50% for example, by the unload device (2a), the capacity of the 1st compressor (1) is adjusted to 60% by the inverter (15), and it is in agreement with sum total target [for the sum total capacity to be 110%] capacity (L1).

And even if sum total target capacity (L1) falls to 100% or less, the capacity of the 2nd compressor (2) is held to 50%, and reduction adjustment of the sum total capacity is carried out by reduction control of the capacity of the 1st compressor (1) at target capacity (L1). Then, if it falls to 70 more% from the time, at i.e., the time of sum total target capacity (L1) being 80%, of the capacity of the 1st compressor (1) falling even to 30% near the minimum value While the capacity of the 2nd compressor (2) is adjusted to 0% (idle state), the capacity of the 1st compressor (1) will be adjusted to 70% by the inverter (15), and it will be in agreement with sum total target capacity (L1). As mentioned above, although the case where the capacity of the 2nd compressor (2) changed between 0% and 50% was explained, when changing between 50% and 100%, it is also the same as that of the above.

(Example)
Hereafter, the example of this invention is explained based on the drawing below the 2nd Fig.
Fig. 2 shows the example which applied this invention to the air conditioner of multi-form. (A) is an outdoor unit and (B) - (F) is five sets of the indoor units of the same internal configuration. Inside the above-mentioned outdoor unit (A) It has an expansion valve (5) and each device (1) - (5) is respectively connected with the 1st compressor (1) and the 2nd compressor (2) which were connected to juxtaposition, and a 4 way change-over valve (3) and the outdoor heat exchanger (4) which has an outdoor blower fan (4a) possible [circulation of a refrigerant] by refrigerant piping (6) --. Moreover, respectively, each above-mentioned indoor unit (B) - (F) is equipped with an expansion valve (11), this expansion valve (11) consists of indoor electric expansion valves for air-conditioning capacity adjustment which can carry out increase and decrease of whenever [valve-opening] of adjustment electrically, and this each device (10) and (11) are connected [the expansion valve] with the indoor heat exchanger (10) which has an indoor blower fan (10a) for it possible [circulation of a refrigerant] by refrigerant piping (12) --.
And five above-mentioned set [of indoor units] (B) - (F) It connects with juxtaposition mutually by refrigerant piping (13) -- respectively, connects with the above-mentioned outdoor unit (A) possible [circulation of a refrigerant], and the refrigerant circulation network (14) is formed. At the time of air conditioning operation By switching a 4 way change-over valve (3) like a drawing destructive line, and circulating a refrigerant like a drawing destructive line arrow head While repeating radiating heat in the open air by the outdoor heat exchanger (4) in the heating value which carried out endoergic from the interior of a room by each indoor heat exchanger (10) -- and air-conditioning each interior of a room, at the time of heating operation He makes transfer of a heating value contrary to the above, and is trying to heat the interior of a room by switching a 4 way change-over valve (3) like a drawing solid line, and circulating a refrigerant like a drawing solid line arrow head.
Moreover, the inverter (15) is connected to the 1st compressor (1) of the above, and it is made as [carry out / carry out height adjustment of the operation frequency of a compressor (1) at eight steps, and / with the output of the frequency setting signal of 10% / 30% to / unit of this inverter (15), / at two or more steps (the time of a halt is included and they are nine steps) / increase and decrease of the capacity of adjustment].
Inhalation opening (2c) and a delivery (2d) are formed in sealing casing (2b) like. moreover, the 2nd compressor (2) -- Fig. 3 -- ****** -- in this sealing casing (2b) The piston (2g) driven through a driving shaft (2f) by the motor (2e) is arranged. The gas (regurgitation gas) fed by this piston (2g) is led to the above-mentioned delivery (2d) through the regurgitation gas pipe (2i) which carries out opening to this regurgitation gas passageway (2b) from a regurgitation gas passageway (2h). And it has a pressure room (2n) the spring (2m) which energizes the valve element (21) which opens and closes opening (2k) which the unload device (2a) has been arranged in the middle of, and prepared this unload device (2a) in the septum (2i) of a regurgitation gas passageway (2h) and this valve element (21) in the valve-opening direction, and behind a valve element (21).
[the above-mentioned regurgitation gas passageway (2h)] And when high pressure (regurgitation gas pressure) acts at the time of close [of the pilot solenoid valve (17) formed in the pilot-pressure installation path (16) which is open for free passage in a pressure room (2n)], the above-mentioned valve element (21) While closing the above-mentioned opening (2k) by the valve element (21), leading the whole quantity of regurgitation gas to a delivery (2d) and making capacity of the 2nd compressor (2) into a full load (100%), when low voltage acts at the time of open [of a pilot solenoid valve (17)] A valve element (21) is energized in the direction of drawing Nakamigi by the energization force of a spring (2m), opening (2k) is opened, a part of regurgitation gas is bypassed in the sealing casing (2b) inner lower part through this opening (2k), and the unload of the capacity of the 2nd compressor (2) is made 50%. That is, this 2nd compressor (2) has a larger and step size smaller than the capacity adjustable range of this 1st compressor (1) than the step size of the 1st compressor (1) of the above, and capacity adjustment is carried out at two or more steps.
Moreover, in Fig. 2 , (20) is an equalization hot gas bypass circuit which connects refrigerant piping (6), (6), and (the discharge tube and suction pipe) before and behind a 4 way change-over valve (3), and the hot gas solenoid valve (21) which carries out open actuation at the time of the low loading in air conditioning operational status and defrosting operation of an outdoor heat exchanger (4) etc. is interposed in this bypass circuit (20).
(22) is a bypass circuit at the time of the heating overload connected to refrigerant piping (6) which turns into a discharge tube at the time of heating operation. Furthermore, in this bypass circuit (22) The auxiliary capacitor

(23) and the high press regulator (24) opened at the time of the high pressure of a refrigerant are interposed, and each indoor heat exchanger (10) -- is bypassed for the refrigerant from a compressor (1) and (2) through this bypass circuit (22) at the time of a heating overload. Each indoor heat exchanger (10) -- He is trying to bypass for refrigerant piping (6) of the downstream.
In addition, the solenoid valve for injections (26) which (25) is a liquid injection bypass circuit which connects the auxiliary capacitor (23) downstream of a bypass circuit (22) to refrigerant piping (6) and a (suction pipe) of the 4 way change-over valve (3) downstream at the time of the above-mentioned heating overload, is interlocked with this liquid injection bypass circuit (25) at actuation of a compressor (1) and (2), and is opened and closed, and the expansion valve (27) are interposed.
Moreover, the lubricating oil from which a supercooling coil and (33) are oil separators, and were separated with this oil separator (33) is returned [a receiver and (31) / an accumulator and (32)] for (30) to both compressors (1) and (2) through an oil path (34).
Furthermore, they are the room temperature sensor which detects the temperature (intake air temperature) of the indoor air to which (TH1) corresponds in each indoor unit (B) - (F), and (TH2) (TH3) the indoor heat exchanger (10) which acts as an evaporator respectively at the time of air conditioning operation. -- It is the temperature sensor which detects the coolant temperature of order. Moreover, in an outdoor unit (A), the temperature sensor with which (TH4) detects the refrigerant discharge temperature of the 1st and 2nd compressors (1) and (2), the evaporation temperature sensor with which (TH5) detects the evaporation temperature of the refrigerant in an outdoor heat exchanger (4) at the time of heating operation, and (TH6) are sensors whenever [suction-gas-temperature / which detects whenever / suction-gas-temperature / of the 1st and 2nd compressors (1) and (2)].
Moreover, the pressure sensor with which (P1) detects regurgitation gas pressure at the time of heating operation, and detects an inspired gas pressure respectively at the time of air conditioning operation, and (HPS) are the high-pressure pressure switches for compressor protection.
Next, the time of air conditioning operation is mentioned as an example, and the displacement control of the 1st and 2nd compressors (1) of the above and (2) is explained based on the flows of control of Fig. 4 . In addition, this displacement control is performed by the outdoor control section (not shown) which it has in an outdoor unit (A).
After detecting the coolant temperature T2 which converts into considerable saturation temperature the inhalation air content gas pressure which was started and was detected by the pressure sensor (P1) at step S1 in Fig. 4 , and is obtained, i.e., evaporation temperature, (the time of heating operation condensation temperature of a refrigerant), It is supposed that P1 control (proportionality-integral control) is performed as feedback control of the sum total capacity of a compressor (1) and (2). It is following formula L1=Lo+Kc{e(t)-e (t-deltat) so that the evaporation temperature T2 may be set to the desired value T2o based on value [of this time of the deflection of the above-mentioned evaporation temperature T2 and its desired value T2o, and last time] e (t), and e (t-deltat) in the target sum total capacity L1 of a compressor (1) and (2) at step S2.
+ deltat / 2Ti (e (t) +e(t-deltat)})
Lo ; current sum total capacity Kc ; Gain (constant)
Ti ; -- integration constant deltat; -- it calculates by the sampling time.
Based on the sum total capacity map of the 1st table, the sum total capacity of the compressor (1) corresponding to the above-mentioned sum total target capacity L1 and (2) is grasped after an appropriate time at step S3. While controlling the capacity of the 1st compressor (1) by the inverter (15) based on the actual capacity map of each compressor (1) of the 2nd table corresponding to this sum total capacity, and (2), the capacity of the 2nd compressor (2) is adjusted by the unload device (2a). And it waits for progress of sampling-time deltat by step S4, returns to the above-mentioned step S1, and the above actuation is repeated.

第　1　表

圧縮機(1), (2)の合計容量%	増大時の目標合計容量L(%)	減少時の目標合計容量L(%)
0	−	−
30	0～35	0～33
40	36～45	34～43
50	46～55	44～53
60	56～65	54～63
70	66～75	64～73
80	76～85	74～83
90	86～95	84～93
100	96～105	94～103
110	106～115	104～113
120	116～125	114～123
130	126～135	124～133
140	136～145	134～143
150	146～155	144～153
160	156～165	154～163
170	166～175	164～173
180	176～185	174～183
190	186～195	184～193
200	196～200	194～200

第　2　表

圧縮機(1)，(2)の合計容量%	第1の圧縮機(1)の容量＋第2の圧縮機(2)の容量 (%)		
0	0+0		
30	30+0		
40	40+0		
50	50+0		
60	60+0		
70	70+0		
80	80+0	30+50	
90	90+0	40+50	
100	100+0	50+50	
110		60+50	
120		70+50	
130		80+50	30+100
140		90+50	40+100
150		100+50	50+100
160			60+100
170			70+100
180			80+100
190			90+100
200			100+100

Here, while the sum total capacity map of the 1st table of the above is classified into the case where the sum total capacity which should control a compressor (1) and (2) is a zero value, and the multistage story (19 steps) which carries out **** increase 10% gradually from a value 30%, and results in a value 200% here, the range of the sum total target capacity L1 is distinguished in the time of increase of capacity, and reduction.
Moreover, the capacity map of each compressor (1) of the 2nd table of the above, and (2) While the capacity of the 1st compressor (1) increases by unit 10% in the range from 30% to 100%, sum total capacity The 1st map on which the capacity of the 2nd compressor (2) holds 0% (halt), and sum total capacity set in the range from 80% to 150%. The capacity of the 1st compressor (1) increases by unit 10% like the above, and the 2nd map on which the capacity of the 2nd compressor (2) holds 50%, and sum total capacity set in the range from 130% to 200%. The capacity of the 1st compressor (1) increases by unit 10%, and the capacity of the 2nd compressor (2) consists of the 3rd map holding 100%. Sum total capacity fluctuates on the 1st map of the above. The capacity of the 1st compressor (1) and in the state of maximum (100%) If sum total capacity increases to 110%, while shifting to the 2nd map and making 50% increase adjustment of the capacity of the 2nd compressor (2) from 0% by the unload device (2a) Reduction adjustment of the capacity of the 1st compressor (1) is made 60% from 100% with an inverter (15). After that When each capacity value of this 2nd map is taken according to the increase and decrease of change of sum total capacity and sum total capacity decreases from 80% to 70% in the condition that the capacity value of the 1st compressor (1) is 30% of the minimum value While shifting to the 1st map of the above and adjusting the capacity of the 2nd compressor (2) to 0%, the capacity of the 1st compressor (1) is adjusted to 70% by the inverter (15).
Similarly sum total capacity fluctuates on the 2nd map. The capacity of the 1st compressor (1) in the state of maximum (100%) If sum total capacity increases from 150% to 160%, while shifting to the 3rd map and

making 100% increase adjustment of the capacity of the 2nd compressor (2) from 50% by the unload device (2a), reduction adjustment of the capacity of the 1st compressor (1) is made 60% from 100% with an inverter (15). After that according to the increase and decrease of change of sum total capacity, take each capacity value of this 3rd map, and when sum total capacity decreases from 130% to 120% in the condition that the capacity value of the 1st compressor (1) is 30% of the minimum value, it shifts to the 2nd map of the above. While reduction adjustment of the capacity of the 2nd compressor (2) is made 50% from 100%, the capacity of the 1st compressor (1) is adjusted to 70% by the inverter (15).

Therefore, step S2 of the flows of control of Fig. 4 of the above constitutes a target capacity operation means (50) by which the sum total target capacity L1 of a compressor (1) and (2) was calculated so that the evaporation temperature T2 may become the set point (desired value T2o). Moreover, the control means (51) which was made to carry out the displacement control of a compressor (1) and (2) to the sum total capacity of the phase near the sum total target capacity L1 is constituted by step S3 in response to the output of the above-mentioned target capacity operation means (50). And the above-mentioned control means (51) is equipped with the capacity map of each compressor (1) of the 2nd table of the above, and (2). After the capacity of the 1st compressor (1) of the above becomes 100% of maximum at the time of increase of the sum total capacity of a compressor (1) and (2), the capacity of the 2nd compressor (2) is increased by one step. On the contrary, after the capacity of the 1st compressor (1) becomes 30% of the minimum value, he associates the above-mentioned inverter (15) and an unload device (2a) mutually, and is trying to control them to decrease the capacity of the 2nd compressor (2) by one step at the time of reduction of sum total capacity.

Therefore, in the above-mentioned example, the sum total target capacity L1 of a compressor (1) and (2) calculates with a target capacity operation means (50) based on the evaporation temperature T2 at the time of air conditioning operation of each indoor unit (B) - (F). And while the displacement control of the capacity of the 1st compressor (1) is carried out by the control means (51) with an inverter (15) so that it may become a capacity stage corresponding to this target sum total capacity L1, the capacity of the 2nd compressor (2) is controlled by the unload device (2a) by the control means (51), and the sum total capacity of this compressor (1) and (2) is adjusted with a precision sufficient in the above-mentioned sum total target capacity L1. Consequently, it will be completed as the desired value T2o by the evaporation temperature T2 of a refrigerant good, and air conditioning air-conditioning of each interior of a room will be carried out good.

In that case, after increase and decrease of the capacity of the 2nd compressor (2) of adjustment are carried out between 0%, 50%, and 100% by the unload device (2a) Even if increase and decrease of the capacity of the 1st compressor (1) of adjustment are carried out with an inverter (15) with change of the sum total target capacity L1 at 40 - 90% of mean value Since a step does not decrease unless it holds the value as it is, a step does not increase unless it becomes 100% of maximum, and it becomes 30% of the minimum value conversely The capacity of the 2nd compressor (2) adjusted by the unload device (2a) can be held to an as much as possible value as it is for a long time, the count of change of the capacity can be reduced effectively, and improvement in the endurance of the 2nd compressor (2) and dependability can be aimed at.

In addition, although the capacity of the 1st compressor (1) was controlled by the inverter (15) to eight steps, the capacity of the 2nd compressor (2) was controlled by the unload device (2a) to two steps and the sum total capacity was controlled by the above-mentioned example to 19 steps, the control number of stages of capacity should just be a multistage story. Moreover, although it increased by one step and 1 step reduction control of the capacity of the 2nd compressor (2) was carried out in the state of the maximum (100%) of the 1st compressor (1) in the state of the minimum value (30%) of the 1st compressor (1), it increases by one step near the maximum of the 1st compressor (1), and, of course, 1 step reduction control may be carried out near the minimum value.

Furthermore, although the time of air conditioning operation was mentioned as the example and the above-mentioned example explained it, it cannot be overemphasized that it is similarly applicable not to mention being applicable similarly to other freezers, such as the usual air conditioner to which one set of an indoor unit corresponds [as opposed to / in addition to this / not only the air conditioner of multi-form but / one set of an outdoor unit], and a thing which unified the interior of a room and an outdoor unit, also in the time of heating operation.

(Effect of the invention)

As explained above, according to this invention, the 1st and 2nd compressors by the case where a displacement control is respectively carried out by the inverter and the unload device When the capacity of the 1st compressor

is near the maximum to what sets up a basic-capacity value with the 2nd compressor by the side of an unload, and adjusts sum total capacity to target capacity value with the 1st compressor by the side of an inverter, And since it restricted near the minimum value by the way and increase and decrease of the capacity of the 2nd compressor of the above of control were carried out By holding the capacity of this 2nd compressor between as much as possible long duration to a value as it is The situation that the start and stop of the 2nd compressor by the side of the unload device which serves as a technical problem especially in such a configuration are repeated can be controlled, the count of capacity change of the 2nd compressor can be reduced effectively, and improvement in the endurance of this 2nd compressor and dependability can be aimed at.

[Translation done.]

TECHNICAL PROBLEM

(Technical problem which invention tends to solve)
By the way, if the change number of stages of the capacity is set as a multistage story when carrying out increase and decrease of the capacity of a compressor of control, refrigerating capacity can be responded good with refrigeration load, improvement in the frozen engine performance can be aimed at, and it is desirable.
It is possible to adjust the sum total capacity of a compressor to a multistage story comparatively, as a low price is also, and to aim at improvement in the frozen engine performance there by carrying out capacity control of the compressor of another side by the unload device, and controlling the sum total capacity of both the compressor device to target capacity value mostly, while preparing two sets of compressors and carrying out capacity control of one compressor with an inverter.
When carrying out a deer and adjusting the sum total capacity of a compressor to a multistage story in this way, one compressor is comparatively fine at an inverter, for example, capacity adjustment is carried out 10% at a unit, and capacity adjustment of the compressor of another side is made 50% and 100% comparatively greatly by the unload device. For this reason, adjustment control of the sum total capacity of a compressor setting up basic capacity value with the compressor for example, by the side of an unload device, carrying out adjustment control of the capacity almost equal to the capacity difference of that basic capacity value and target capacity value with the compressor by the side of an inverter, and adjusting the sum total capacity of a compressor to target capacity value is performed.
However, when target capacity value changes in that case according to change of refrigeration load etc. (for example, when target capacity value carries out both-way fluctuation between 40% and 50%), the compressor by the side of an unload device repeats and carries out the start and stop of actuation and the halt by the capacity between 0% and 50%, therefore the endurance of this compressor falls, and the fault which causes lowering of the dependability arises.
This invention is made in view of this point. The object When carrying out capacity control of two sets of the compressors by the inverter and the unload device respectively like the above, increase and decrease of the sum total capacity of two sets of compressors of adjustment are carried out maintaining the capacity condition of the compressor by the side of an unload device for a long time as much as possible. It is shown in being able to adjust refrigerating capacity to a multistage story and aiming at improvement in the frozen engine performance, lessening the start-and-stop frequency of the compressor by the side of an unload device as much as possible, and aiming at improvement in the endurance by making it converge on target capacity value good.

[Translation done.]

MEANS

(The means for solving a technical problem)
In order to attain the above-mentioned object, the concrete solution means of this invention The 1st compressor (1) by which capacity adjustment is carried out into a predetermined capacity adjustable range with an inverter (15) at two or more steps as shown in drawing 1 , It has the 2nd compressor (2) in which capacity adjustment is carried out by the unload device (2a) at two or more steps with a larger and step size smaller than the above-mentioned capacity adjustable range of this 1st compressor (1) than the step size of the 1st compressor (1) of the above. It is premised on the compressor capacity control equipment of the freezer which controlled the sum total capacity of these both compressors (1) and (2) on the multistage story. And the control means (51) which controls the above-mentioned inverter (15) and an unload device (2a) to adjust the sum total capacity of the above-mentioned compressor (1), and (2) to the capacity of the phase near sum total target capacity (L1) is made to have in response to the output of a target capacity operation means (50) calculate the sum total target capacity (L1) of the above-mentioned compressor (1) and (2), and this target capacity operation means (50). Moreover, it sets at the time of buildup of the sum total target capacity (L1) calculated with the above-mentioned target capacity operation means (50). When the capacity of the 1st compressor (1) is the following near the maximum, sequential buildup only of the capacity of the 1st compressor (1) is carried out. Both compressors (1), When sum total target capacity (L1) increases further after it adjusted the sum total capacity of (2) to sum total target capacity (L1) and the capacity of the 1st compressor (1) rose [the capacity of the 2nd compressor (2)] to near the maximum in the condition of under maximum Only one step increases the capacity of the 2nd compressor (2), and only the capacity of the part which subtracted the capacity for one step of the 1st compressor (1) from the capacity for one step of the 2nd compressor (2) decreases the capacity of the 1st compressor (1). Both compressors (1), While adjusting the sum total capacity of (2) to sum total target capacity (L1), it sets at the time of reduction of sum total target capacity (L1). When the capacity of the 1st compressor (1) has exceeded near the minimum value, sequential reduction only of the capacity of the 1st compressor (1) is carried out. Both compressors (1), The sum total capacity of (2) is adjusted to sum total target capacity (L1). Both compressors (1), When sum total target capacity (L1) decreases further after the capacity of the 1st compressor (1) fell to near the minimum value in the condition that (2) is driving Only one step decreases the capacity of the 2nd compressor (2), and only the capacity of the part which subtracted the capacity for one step of the 1st compressor (1) from the capacity for one step of the 2nd compressor (2) increases the capacity of the 1st compressor (1). Both compressors (1), It considered as a configuration which adjusts the sum total capacity of (2) to sum total target capacity (L1).

[Translation done.]

OPERATION

(Operation)
By the above configuration, by this invention, if the sum total target capacity (L1) of a compressor (1) and (2) calculates with a target capacity operation means (50) at the time of frozen operation While capacity control of the 1st compressor (1) is carried out by the control means (51) with an inverter (15) Since capacity control of the 2nd compressor (2) is carried out by the control means (51) by the unload device (2a) Also when the above-mentioned sum total target capacity (L1) is finely set as a multistage story, coincidence adjustment of the sum total capacity of both compressors (1) and (2) is carried out mostly at the above-mentioned target capacity (L1), and improvement in the frozen engine performance is achieved.
In that case, the capacity of the 2nd compressor (2) by the side of an unload device (2a) Since buildup change is not carried out unless the capacity of the 1st compressor (1) by the side of an inverter (15) becomes 100% near the maximum For example, in changing sum total target capacity (L1) between 50% and 60%, only the capacity of the 1st compressor (1) changes between 50% and 60%, and the capacity of the 2nd compressor (2) holds 0% (idle state). And after the capacity of the 1st compressor (1) becomes 100% when sum total target capacity (L1) increases from 100% to 110% that is, [for example,] While the capacity of the 2nd compressor (2) is adjusted to 50% for example, by the unload device (2a), the capacity of the 1st compressor (1) is adjusted to 60% by the inverter (15), and it is in agreement with sum total target [for the sum total capacity to be 110%] capacity (L1).

And even if sum total target capacity (L1) falls to 100% or less, the capacity of the 2nd compressor (2) is held to 50%, and reduction adjustment of the sum total capacity is carried out by reduction control of the capacity of the 1st compressor (1) at target capacity (L1). Then, if it falls to 70 more% from the event, at i.e., the event of sum total target capacity (L1) being 80%, of the capacity of the 1st compressor (1) falling even to 30% near the minimum value While the capacity of the 2nd compressor (2) is adjusted to 0% (idle state), the capacity of the 1st compressor (1) will be adjusted to 70% by the inverter (15), and it will be in agreement with sum total target capacity (L1). As mentioned above, although the case where the capacity of the 2nd compressor (2) changed between 0% and 50% was explained, when changing between 50% and 100%, it is also the same as that of the above.

[Translation done.]

* NOTICES *

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

EXAMPLE

(Example)
Hereafter, the example of this invention is explained based on the drawing below the 2nd Fig.
Fig. 2 shows the example which applied this invention to the air conditioner of multi-form. (A) is an outdoor unit and (B) - (F) is five sets of the indoor units of the same internal configuration. Inside the above-mentioned outdoor unit (A) It has an expansion valve (5) and each device (1) - (5) is respectively connected with the 1st compressor (1) and the 2nd compressor (2) which were connected to juxtaposition, and a 4 way change-over valve (3) and the outdoor heat exchanger (4) which has an outdoor blower fan (4a) possible [circulation of a refrigerant] by refrigerant piping (6) --. Moreover, respectively, each above-mentioned indoor unit (B) - (F) is equipped with an expansion valve (11), this expansion valve (11) consists of indoor electric expansion valves for air-conditioning capacity adjustment which can carry out increase and decrease of whenever [valve-opening] of adjustment electrically, and this each device (10) and (11) are connected [the expansion valve] with the indoor heat exchanger (10) which has an indoor blower fan (10a) for it possible [circulation of a refrigerant] by refrigerant piping (12) --.
And five above-mentioned set [of indoor units] (B) - (F) It connects with juxtaposition mutually by refrigerant piping (13) -- respectively, connects with the above-mentioned outdoor unit (A) possible [circulation of a refrigerant], and the refrigerant circulation network (14) is formed. At the time of air conditioning operation By switching a 4 way change-over valve (3) like a drawing destructive line, and circulating a refrigerant like a drawing destructive line arrow head While repeating radiating heat in the open air by the outdoor heat exchanger (4) in the heating value which carried out endoergic from the interior of a room by each indoor heat exchanger (10) -- and air-conditioning each interior of a room, at the time of heating operation He makes transfer of a heating value contrary to the above, and is trying to heat the interior of a room by switching a 4 way change-over valve (3) like a drawing solid line, and circulating a refrigerant like a drawing solid line arrow head.
Moreover, the inverter (15) is connected to the 1st compressor (1) of the above, and it is made as [carry out / carry out height adjustment of the operation frequency of a compressor (1) at eight steps, and / with the output of the frequency setting signal of 10% / 30% to / unit of this inverter (15), / at two or more steps (the time of a halt is included and they are nine steps) / increase and decrease of the capacity of adjustment].
Inhalation opening (2c) and a delivery (2d) are formed in sealing casing (2b) like. moreover, the 2nd compressor (2) -- Fig. 3 -- ****** -- in this sealing casing (2b) The piston (2g) driven through a driving shaft (2f) by the motor (2e) is arranged. The gas (regurgitation gas) fed by this piston (2g) is led to the above-mentioned delivery (2d) through the regurgitation gas pipe (2i) which carries out opening to this regurgitation gas passageway (2b) from a regurgitation gas passageway (2h). And it has a pressure room (2n) the spring (2m) which energizes the valve element (21) which opens and closes opening (2k) which the unload device (2a) has been arranged in the middle of, and prepared this unload device (2a) in the septum (2i) of a regurgitation gas passageway (2h) and this valve element (21) in the valve-opening direction, and behind a valve element (21). [the above-mentioned regurgitation gas passageway (2h)] And when high pressure (regurgitation gas pressure) acts at the time of close [of the pilot solenoid valve (17) formed in the pilot-pressure installation path (16) which is open for free passage in a pressure room (2n)], the above-mentioned valve element (21) While closing the above-mentioned opening (2k) by the valve element (21), leading the whole quantity of regurgitation gas to a delivery (2d) and making capacity of the 2nd compressor (2) into a full load (100%), when low voltage acts at the time of open [of a pilot solenoid valve (17)] A valve element (21) is energized in the direction of drawing Nakamigi by the energization force of a spring (2m), opening (2k) is opened, a part of regurgitation gas is

bypassed in the sealing casing (2b) inner lower part through this opening (2k), and the unload of the capacity of the 2nd compressor (2) is made 50%. That is, this 2nd compressor (2) has a larger and step size smaller than the capacity adjustable range of this 1st compressor (1) than the step size of the 1st compressor (1) of the above, and capacity adjustment is carried out at two or more steps.
Moreover, in Fig. 2 , (20) is an equalization hot gas bypass circuit which connects refrigerant piping (6), (6), and (the discharge tube and suction pipe) before and behind a 4 way change-over valve (3), and the hot gas solenoid valve (21) which carries out open actuation at the time of the low loading in air conditioning operational status and defrosting operation of an outdoor heat exchanger (4) etc. is interposed in this bypass circuit (20).
(22) is a bypass circuit at the time of the heating overload connected to refrigerant piping (6) which turns into a discharge tube at the time of heating operation. Furthermore, in this bypass circuit (22) The auxiliary capacitor (23) and the high press regulator (24) opened at the time of the high pressure of a refrigerant are interposed, and each indoor heat exchanger (10) -- is bypassed for the refrigerant from a compressor (1) and (2) through this bypass circuit (22) at the time of a heating overload. Each indoor heat exchanger (10) -- He is trying to bypass for refrigerant piping (6) of the downstream.
In addition, the solenoid valve for injections (26) which (25) is a liquid injection bypass circuit which connects the auxiliary capacitor (23) downstream of a bypass circuit (22) to refrigerant piping (6) and a (suction pipe) of the 4 way change-over valve (3) downstream at the time of the above-mentioned heating overload, is interlocked with this liquid injection bypass circuit (25) at actuation of a compressor (1) and (2), and is opened and closed, and the expansion valve (27) are interposed.
Moreover, the lubricating oil from which a supercooling coil and (33) are oil separators, and were separated with this oil separator (33) is returned [a receiver and (31) / an accumulator and (32)] for (30) to both compressors (1) and (2) through an oil path (34).
Furthermore, they are the room temperature sensor which detects the temperature (intake air temperature) of the indoor air to which (TH1) corresponds in each indoor unit (B) - (F), and (TH2) (TH3) the indoor heat exchanger (10) which acts as an evaporator respectively at the time of air conditioning operation. -- It is the temperature sensor which detects the coolant temperature of order. Moreover, in an outdoor unit (A), the temperature sensor with which (TH4) detects the refrigerant discharge temperature of the 1st and 2nd compressors (1) and (2), the evaporation temperature sensor with which (TH5) detects the evaporation temperature of the refrigerant in an outdoor heat exchanger (4) at the time of heating operation, and (TH6) are sensors whenever [suction-gas-temperature / which detects whenever / suction-gas-temperature / of the 1st and 2nd compressors (1) and (2)].
Moreover, the pressure sensor with which (P1) detects regurgitation gas pressure at the time of heating operation, and detects an inspired gas pressure respectively at the time of air conditioning operation, and (HPS) are the high-pressure pressure switches for compressor protection.
Next, the time of air conditioning operation is mentioned as an example, and the displacement control of the 1st and 2nd compressors (1) of the above and (2) is explained based on the flows of control of Fig. 4 . In addition, this displacement control is performed by the outdoor control section (not shown) which it has in an outdoor unit (A).
After detecting the coolant temperature T2 which converts into considerable saturation temperature the inhalation air content gas pressure which was started and was detected by the pressure sensor (P1) at step S1 in Fig. 4 , and is obtained, i.e., evaporation temperature, (the time of heating operation condensation temperature of a refrigerant), It is supposed that P1 control (proportionality-integral control) is performed as feedback control of the sum total capacity of a compressor (1) and (2). It is following formula L1=Lo+Kc{e(t)-e (t-deltat) so that the evaporation temperature T2 may be set to the desired value T2o based on value [of this time of the deflection of the above-mentioned evaporation temperature T2 and its desired value T2o, and last time] e (t), and e (t-deltat) in the target sum total capacity L1 of a compressor (1) and (2) at step S2.
+ deltat / 2Ti (e (t) +e(t-deltat)})
Lo ; current sum total capacity Kc ; Gain (constant)
Ti ; -- integration constant deltat; -- it calculates by the sampling time.
Based on the sum total capacity map of the 1st table, the sum total capacity of the compressor (1) corresponding to the above-mentioned sum total target capacity L1 and (2) is grasped after an appropriate time at step S3.
While controlling the capacity of the 1st compressor (1) by the inverter (15) based on the actual capacity map of each compressor (1) of the 2nd table corresponding to this sum total capacity, and (2), the capacity of the 2nd

compressor (2) is adjusted by the unload device (2a). And it waits for progress of sampling-time deltat by step S4, returns to the above-mentioned step S1, and the above actuation is repeated.

第 1 表

圧縮機(1), (2)の合計容量%	増大時の目標合計容量L(%)	減少時の目標合計容量L(%)
0	—	—
30	0～35	0～33
40	36～45	34～43
50	46～55	44～53
60	56～65	54～63
70	66～75	64～73
80	76～85	74～83
90	86～95	84～93
100	96～105	94～103
110	106～115	104～113
120	116～125	114～123
130	126～135	124～133
140	136～145	134～143
150	146～155	144～153
160	156～165	154～163
圧縮機(1), (2)の合計容量%	増大時の目標合計容量L(%)	減少時の目標合計容量L(%)
170	166～175	164～173
180	176～185	174～183
190	186～195	184～193
200	196～200	194～200

第 2 表

圧縮機(1), (2)の合計容量%	第1の圧縮機(1)の容量＋第2の圧縮機(2)の容量 (%)		
0	0+0		
30	30+0		
40	40+0		
50	50+0		
60	60+0		
70	70+0		
80	80+0	30+50	
90	90+0	40+50	
100	100+0	50+50	
110		60+50	
120		70+50	
130		80+50	30+100
140		90+50	40+100
150		100+50	50+100
160			60+100
170			70+100
180			80+100
190			90+100
200			100+100

Here, while the sum total capacity map of the 1st table of the above is classified into the case where the sum total capacity which should control a compressor (1) and (2) is a zero value, and the multistage story (19 steps) which carries out **** increase 10% gradually from a value 30%, and results in a value 200% here, the range of the sum total target capacity L1 is distinguished in the time of increase of capacity, and reduction.
Moreover, the capacity map of each compressor (1) of the 2nd table of the above, and (2) While the capacity of the 1st compressor (1) increases by unit 10% in the range from 30% to 100%, sum total capacity The 1st map on which the capacity of the 2nd compressor (2) holds 0% (halt), and sum total capacity set in the range from 80% to 150%. The capacity of the 1st compressor (1) increases by unit 10% like the above, and the 2nd map on which the capacity of the 2nd compressor (2) holds 50%, and sum total capacity set in the range from 130% to 200%. The capacity of the 1st compressor (1) increases by unit 10%, and the capacity of the 2nd compressor (2) consists of the 3rd map holding 100%. Sum total capacity fluctuates on the 1st map of the above. The capacity of the 1st compressor (1) and in the state of maximum (100%) If sum total capacity increases to 110%, while shifting to the 2nd map and making 50% increase adjustment of the capacity of the 2nd compressor (2) from 0% by the unload device (2a) Reduction adjustment of the capacity of the 1st compressor (1) is made 60% from 100% with an inverter (15). After that When each capacity value of this 2nd map is taken according to the increase and decrease of change of sum total capacity and sum total capacity decreases from 80% to 70% in the condition that the capacity value of the 1st compressor (1) is 30% of the minimum value While shifting to the 1st map of the above and adjusting the capacity of the 2nd compressor (2) to 0%, the capacity of the 1st compressor (1) is adjusted to 70% by the inverter (15).
Similarly sum total capacity fluctuates on the 2nd map. The capacity of the 1st compressor (1) in the state of maximum (100%) If sum total capacity increases from 150% to 160%, while shifting to the 3rd map and

making 100% increase adjustment of the capacity of the 2nd compressor (2) from 50% by the unload device (2a), reduction adjustment of the capacity of the 1st compressor (1) is made 60% from 100% with an inverter (15). After that according to the increase and decrease of change of sum total capacity, take each capacity value of this 3rd map, and when sum total capacity decreases from 130% to 120% in the condition that the capacity value of the 1st compressor (1) is 30% of the minimum value, it shifts to the 2nd map of the above. While reduction adjustment of the capacity of the 2nd compressor (2) is made 50% from 100%, the capacity of the 1st compressor (1) is adjusted to 70% by the inverter (15).
Therefore, step S2 of the flows of control of Fig. 4 of the above constitutes a target capacity operation means (50) by which the sum total target capacity L1 of a compressor (1) and (2) was calculated so that the evaporation temperature T2 may become the set point (desired value T2o). Moreover, the control means (51) which was made to carry out the displacement control of a compressor (1) and (2) to the sum total capacity of the phase near the sum total target capacity L1 is constituted by step S3 in response to the output of the above-mentioned target capacity operation means (50). And the above-mentioned control means (51) is equipped with the capacity map of each compressor (1) of the 2nd table of the above, and (2).

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
Drawing 1 is a block diagram showing the configuration of this invention. The refrigerant piping schematic diagram which Figs. 2 thru/or 4 showed the example of this invention, and applied drawing 2 to the air conditioner of a multi-type, drawing showing [3] the concrete internal configuration of the 2nd compressor, and drawing 4 are flow chart drawings showing the capacity control of a compressor.
(1) -- The 1st compressor, (2) -- The 2nd compressor, -- (2a) unload device, (21) -- A valve element, -- (2n) pressure room, (14) [-- A refrigerant piping system, (15)] [-- An inverter, (17)] [-- A pilot solenoid valve, (50)] [-- A target capacity operation means, (51)] [-- Control means.]

[Translation done.]

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㉔発明の名称　冷凍装置の圧縮機容量制御装置

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明　細　書

1. 発明の名称

冷凍装置の圧縮機容量制御装置

2. 特許請求の範囲

(1) インバータ(15)により容量調整される第1の圧縮機(1)と、アンロード機構(2a)により容量調整される第2の圧縮機(2)とを備え、該両圧縮機(1),(2)の合計容量を多段階に制御するようにした冷凍装置の圧縮機容量制御装置であって、上記圧縮機(1),(2)の合計目標容量(L_1)を演算する目標容量演算手段(50)と、該目標容量演算手段(50)の出力を受け、合計目標容量(L_1)に近い段階の容量に上記圧縮機(1),(2)の合計容量を調整するよう上記インバータ(15)及びアンロード機構(2a)を制御する制御手段(51)とを備え、該制御手段(51)は、上記第1の圧縮機(1)の容量が最大値近傍になった後に第2の圧縮機(2)の容量を増大させ、第1の圧縮機(1)の容量が最小値近傍になった後に第2の圧縮機(2)の容量を減少させるよう上記インバータ(15)及びアンロード機構(2a)を相互に関連付けて制御するものであることを特徴とする冷凍装置の圧縮機容量制御装置。

3. 発明の詳細な説明

（産業上の利用分野）

本発明は、冷凍装置の圧縮機容量制御装置に関し、特に、圧縮機の頻繁な容量変化に起因する耐久性の低下の防止対策に関する。

（従来の技術）

従来、この種の冷凍装置の圧縮機容量制御装置として、例えば特開昭59-56649号公報等に開示されるように、空気調和機において、インバータにより容量調整される圧縮機を備え、該圧縮機の容量を室内の空調負荷の変化等に応じてインバータで増減制御して、空調能力を空調負荷に良好に対応させて、室内の快適空調を行うものが知られている。

（発明が解決しようとする問題点）

ところで、圧縮機の容量を増減制御する場合、その容量の変化段数を多段階に設定すれば、冷凍

能力を冷凍負荷により良好に対応できて、冷凍性能の向上を図ることができ、好ましい。

そこで、例えば2台の圧縮機を設け、一方の圧縮機をインバータで容量制御すると共に、他方の圧縮機をアンロード機構で容量制御して、両圧縮機の合計容量をほぼ目標容量値に制御することにより、比較的低価格でもって圧縮機の合計容量を多段階に調整して、冷凍性能の向上を図ることが考えられる。

しかして、このように圧縮機の合計容量を多段階に調整する場合、一方の圧縮機はインバータで比較的細かく，例えば10%刻みに容量調整され、他方の圧縮機はアンロード機構で例えば50%と100%とに比較的大きく容量調整されるものである。このため、圧縮機の合計容量の調整制御は、例えばアンロード機構側の圧縮機で基礎容量値を設定し、その基礎容量値と目標容量値との容量差にほぼ等しい容量をインバータ側の圧縮機で調整制御して、圧縮機の合計容量を目標容量値に調整することが行われる。

しかるに、その場合、目標容量値が冷凍負荷の変化等に応じて変化する場合、例えば目標容量値が50%と60%との間で往復変動する場合には、アンロード機構側の圧縮機が0%と50%との間の容量で作動と停止とを繰返して発停し、そのため該圧縮機の耐久性が低下して、その信頼性の低下を招く欠点が生じる。

本発明は斯かる点に鑑みてなされたものであり、その目的は、上記の如く2台の圧縮機を各々インバータとアンロード機構とで容量制御する場合、アンロード機構側の圧縮機の容量状態を可及的に長く維持しつつ2台の圧縮機の合計容量を増減調整して、目標容量値に良好に収束させることにより、アンロード機構側の圧縮機の発停頻度を可及的に少なくしてその耐久性の向上を図りつつ、冷凍能力を多段階に調整し得て、冷凍性能の向上を図ることにある。

（問題点を解決するための手段）

上記目的を達成するため、本発明の具体的な解決手段は、第1図に示すように、インバータ(15)により容量調整される第1の圧縮機(1)と、アンロード機構(2a)により容量調整される第2の圧縮機(2)とを備え、該両圧縮機(1),(2)の合計容量を多段階に制御するようにした冷凍装置の圧縮機容量制御装置を前提とする。そして、上記圧縮機(1),(2)の合計目標容量(L_1)を演算する目標容量演算手段(50)と、該目標容量演算手段(50)の出力を受け、合計目標容量(L_1)に近い段階の容量に上記圧縮機(1),(2)の合計容量を調整するよう上記インバータ(15)及びアンロード機構(2a)を制御する制御手段(51)とを設ける。そして、上記制御手段(51)を、上記第1の圧縮機(1)の容量が最大値近傍になった後に第2の圧縮機(2)の容量を増大させ、第1の圧縮機(1)の容量が最小値近傍になった後に第2の圧縮機(2)の容量を減少させるよう上記インバータ(15)及びアンロード機構(2a)とを相互に関連付けて制御させる構成としたものである。

（作用）

以上の構成により、本発明では、冷凍運転時、圧縮機(1),(2)の合計目標容量(L_1)が目標容量演算手段(50)で演算されると、第1の圧縮機(1)が制御手段(51)によりインバータ(15)で容量制御されると共に、第2の圧縮機(2)が制御手段(51)によりアンロード機構(2a)で容量制御されるので、上記合計目標容量(L_1)が細かく多段階に設定される場合にも、両圧縮機(1),(2)の合計容量がほぼ上記目標容量(L_1)に一致調整されて、冷凍性能の向上が図られる。

その場合、アンロード機構(2a)側の第2の圧縮機(2)の容量は、インバータ(15)側の第1の圧縮機(1)の容量が最大値近傍の例えば100%にならない限り増大変化しないので、例えば合計目標容量(L_1)が50%と60%との間で変動する場合には、第1の圧縮機(1)の容量のみが50%と60%との間で変化して、第2の圧縮機(2)の容量は0%（停止状態）を保持している。そして、例えば合計目標容量(L_1)が100%から110%に増大した場合つまり第1の圧縮機(1)の容量が100%になった後は、第2の圧縮機(2)の容量が例えばアンロー

ド機構(2a)で50%に調整されると共に、第1の圧縮機(1) の容量がインバータ(15)で60%に調整されて、その合計容量が110 %の合計目標容量(L_1)に一致する。

そして、合計目標容量(L_1) が100 %以下に低下しても、第2の圧縮機(2) の容量は50%に保持されて、第1の圧縮機(1) の容量の減少制御により合計容量が目標容量(L_1) に減少調整される。その後、第1の圧縮機(1) の容量が最小値近傍の例えば30%にまで低下した時点、つまり合計目標容量(L_1) が80%の時点からさらに70%に低下すると、第2の圧縮機(2) の容量が0 %(停止状態)に調整されると共に、第1の圧縮機(1) の容量がインバータ(15)で70%に調整されて、合計目標容量(L_1) に一致することになる。以上、第2の圧縮機(2) の容量が0 %と50%との間で変化する場合を説明したが、50%と100 %との間で変化する場合にも上記と同様である。

(実施例)

以下、本発明の実施例を第2図以下の図面に基いて説明する。

第2図は本発明をマルチ型式の空気調和機に適用した実施例を示し、(A) は室外ユニット、(B)～(F) は同一内部構成の5台の室内ユニットであって、上記室外ユニット(A) の内部には、互いに並列に接続された第1圧縮機(1) 及び第2圧縮機(2) と、四路切換弁(3) と、室外送風ファン(4a)を有する室外熱交換器(4) と、膨張弁(5) とが備えられ、該各機器(1) ～(5) は各々冷媒配管(6)…で冷媒の流通可能に接続されている。また、上記各室内ユニット(B) ～(F) は、各々、室内送風ファン(10a) を有する室内熱交換器(10)と、膨張弁(11)とを備え、該膨張弁(11)は、その弁開度が電気的に増減調整できる空調能力調整用の室内電動膨張弁で構成されていて、該各機器(10),(11)は冷媒配管(12)…で冷媒の流通可能に接続されている。

そして、上記5台の室内ユニット(B) ～(F) は、各々冷媒配管(13)…で互いに並列に接続されて上記室外ユニット(A) に冷媒の循環可能に接続されて冷媒循環系統(14)が形成されていて、冷房運転時には、四路切換弁(3) を図中破線の如く切換えて冷媒を図中破線矢印の如く循環させることにより、各室内熱交換器(10)…で室内から吸熱した熱量を室外熱交換器(4) で外気に放熱することを繰返して各室内を冷房する一方、暖房運転時には、四路切換弁(3) を図中実線の如く切換えて冷媒を図中実線矢印の如く循環させることにより、熱量の授受を上記とは逆にして、室内を暖房するようにしている。

また、上記第1圧縮機(1) にはインバータ(15)が接続されていて、該インバータ(15)の30%から10%刻みの周波数設定信号の出力により、圧縮機(1) の運転周波数を8段階に高低調整して、その容量を複数段階(停止時を含んで9段階) に増減調整するようになされている。

また、第2圧縮機(2) は、第3図に詳示するように、密閉ケーシング(2b)に吸入口(2c)と吐出口(2d)とが形成され、該密閉ケーシング(2b)内には、モータ(2e)により駆動軸(2f)を介して駆動されるピストン(2g)が配置され、該ピストン(2g)により圧送されるガス(吐出ガス) を吐出ガス通路(2h)から該吐出ガス通路(2b)に開口する吐出ガス管(2i)を介して、上記吐出口(2d)に導くようになっている。そして、上記吐出ガス通路(2h)の途中には、アンロード機構(2a)が配置され、該アンロード機構(2a)は、吐出ガス通路(2h)の隔壁(2j)に設けた開口(2k)を開閉する弁体(2l)と、該弁体(2l)を開弁方向に付勢するスプリング(2m)と、弁体(2l)の後方に圧力室(2n)とを有する。そして、上記弁体(2l)は、圧力室(2n)に連通するパイロット圧導入通路(16)に設けたパイロット電磁弁(17)の閉時に高圧(吐出ガス圧) が作用することにより、上記開口(2k)を弁体(2l)で閉じて、吐出ガスの全量を吐出口(2d)に導き、第2圧縮機(2) の容量をフルロード(100%) にする一方、パイロット電磁弁(17)の開時には低圧が作用することにより、スプリング(2m)の付勢力で弁体(2l)を図中右方向に付勢して開口(2k)を開き、吐出ガスの一部を該開口(2k)を介して密閉ケーシング(2b)内下部にバイパス

して、第2圧縮機(2) の容量を50%にアンロードするものである。

また、第2図において、(20)は四路切換弁(3) 前後の冷媒配管(6),(6)(吐出管と吸入管) を接続する均圧ホットガスバイパス回路であって、該バイパス回路(20)には、冷房運転状態での低負荷時及び室外熱交換器(4) の除霜運転時等に開作動するホットガス電磁弁(21)が介設されている。

さらに、(22)は暖房運転時に吐出管となる冷媒配管(6) に接続された暖房過負荷時バイパス回路であって、該バイパス回路(22)には、補助コンデンサ(23)及び、冷媒の高圧時に開く高圧制御弁(24)が介設されており、暖房過負荷時に圧縮機(1),(2) からの冷媒を該バイパス回路(22)を介して各室内熱交換器(10)…をバイパスして、各室内熱交換器(10)…下流側の冷媒配管(6) にバイパスするようにしている。

加えて、(25)は上記暖房過負荷時バイパス回路(22)の補助コンデンサ(23)下流側を、四路切換弁(3) 下流側の冷媒配管(6)(吸入管) に接続するリキッドインジェクションバイパス回路であって、該リキッドインジェクションバイパス回路(25)には圧縮機(1),(2) の作動に連動して開閉するインジェクション用電磁弁(26)と、膨張弁(27)とが介設されている。

また、(30)はレシーバ、(31)はアキュムレータ、(32)は過冷却コイル、(33)は油分離器であって、該油分離器(33)で分離された潤滑油は油通路(34)を介して両圧縮機(1),(2) に戻される。

さらに、各室内ユニット(B) ～(F) において、(TH1) は対応する室内の空気の温度(吸込空気温度) を検出する室温センサ、(TH2) 及び(TH3) は各々冷房運転時に蒸発器として作用する室内熱交換器(10)…前後の冷媒温度を検出する温度センサである。また、室外ユニット(A) において、(TH4) は第1及び第2圧縮機(1),(2) の冷媒吐出温度を検出する温度センサ、(TH5) は暖房運転時に室外熱交換器(4) での冷媒の蒸発温度を検出する蒸発温度センサ、(TH6) は第1及び第2圧縮機(1),(2) への吸入ガス温度を検出する吸入ガス温度センサである。また、(P1)は暖房運転時には吐出ガス圧力を、冷房運転時には吸入ガス圧力を各々検出する圧力センサ、(HPS) は圧縮機保護用の高圧圧力開閉器である。

次に、上記第1及び第2圧縮機(1),(2) の容量制御を冷房運転時を例に挙げて第4図の制御フローに基いて説明する。尚、この容量制御は、室外ユニット(A) 内に備える室外制御部(図示せず) により行われる。

第4図において、スタートして、ステップS_1 で圧力センサ(P_1) により検出した吸入空気量ガス圧力を相当飽和温度に換算して得られる冷媒温度T_2 、つまり蒸発温度(暖房運転時には冷媒の凝縮温度) を検出した後、圧縮機(1),(2) の合計容量のフィードバック制御としてPI制御(比例- 積分制御) を行うこととし、ステップS_2 で圧縮機(1),(2) の目標合計容量L_1 を、上記蒸発温度T_2 とその目標値$T_{2}o$ との偏差の，今回と前回の値$e(t)$, $e(t-\Delta t)$に基いて、蒸発温度T_2 がその目標値$T_{2}o$ になるよう下記式

$$L_1 = L_o + K_c\ \{e(t) - e(t-\Delta t)$$
$$+(\Delta t / 2\ T_i)(e(t) + e(t-\Delta t))\}$$

L_o ；現在の合計容量

K_c ；ゲイン(定数)

T_i ；積分定数

Δt ；サンプリング時間

で演算する。

しかる後、ステップS_3 で第1表の合計容量マップに基いて上記合計目標容量L_1 に対応した圧縮機(1),(2) の合計容量を把握して、この合計容量に対応する第2表の各圧縮機(1),(2) の実際の容量マップに基いて第1の圧縮機(1) の容量をインバータ(15)で制御すると共に、第2の圧縮機(2) の容量をアンロード機構(2a)で調整する。そして、ステップS_4 でサンプリング時間Δt の経過を待って上記ステップS_1 に戻って、以上の動作を繰返す。

第 1 表

圧縮機(1),(2)の合計容量%	増大時の (%) 目標合計容量L_1	減少時の (%) 目標合計容量L_1
0	—	—
30	0~35	0~33
40	36~45	34~43
50	46~55	44~53
60	56~65	54~63
70	66~75	64~73
80	76~85	74~83
90	86~95	84~93
100	96~105	94~103
110	106~115	104~113
120	116~125	114~123
130	126~135	124~133
140	136~145	134~143
150	146~155	144~153
160	156~165	154~163
170	166~175	164~173
180	176~185	174~183
190	186~195	184~193
200	196~200	194~200

第 2 表

圧縮機(1),(2)の合計容量%	第1の圧縮機(1)の容量+第2の圧縮機(2)の容量(%)		
0	0+0		
30	30+0		
40	40+0		
50	50+0		
60	60+0		
70	70+0		
80	80+0	30+50	
90	90+0	40+50	
100	100+0	50+50	
110		60+50	
120		70+50	
130		80+50	30+100
140		90+50	40+100
150		100+50	50+100
160			60+100
170			70+100
180			80+100
190			90+100
200			100+100

ここに、上記第1表の合計容量マップは、圧縮機(1),(2)の制御すべき合計容量が零値の場合と、30%値から漸次10%づつ増大して200%値に至る多段階(19段階)に区分されていると共に、合計目標容量L_1の範囲が容量の増大時と減少時とで区別されている。

また、上記第2表の各圧縮機(1),(2)の容量マップは、合計容量が30%から100%までの範囲において、第1の圧縮機(1)の容量が10%刻みで増大すると共に、第2の圧縮機(2)の容量が0%(停止)を保持する第1マップと、合計容量が80%から150%までの範囲において、第1の圧縮機(1)の容量が上記と同様に10%刻みで増大し、第2の圧縮機(2)の容量が50%を保持する第2のマップと、合計容量が130%から200%までの範囲において、第1の圧縮機(1)の容量が10%刻みで増大し、第2の圧縮機(2)の容量が100%を保持する第3マップとからなる。そして、上記第1マップで合計容量が増減し、第1の圧縮機(1)の容量が最大値(100%)の状態で、合計容量が110%に増大すると、第2マップに移行して、第2の圧縮機(2)の容量がアンロード機構(2a)で0%から50%に増大調整されると共に、第1の圧縮機(1)の容量がインバータ(15)で100%から60%に減少調整され、その後は、合計容量の増減変化に応じてこの第2マップの各容量値を取り、第1の圧縮機(1)の容量値が最小値の30%の状態で合計容量が80%から70%に減少する場合には、上記第1マップに移行して、第2の圧縮機(2)の容量が0%に調整されると共に、第1の圧縮機(1)の容量がインバータ(15)で70%に調整される。

同様に、第2マップで合計容量が増減し、第1の圧縮機(1)の容量が最大値(100%)の状態で、合計容量が150%から160%に増大すると、第3マップに移行して、第2の圧縮機(2)の容量がアンロード機構(2a)で50%から100%に増大調整されると共に、第1の圧縮機(1)の容量がインバータ(15)で100%から60%に減少調整される。その後は、合計容量の増減変化に応じてこの第3マップの各容量値を取り、第1の圧縮機(1)の容量値

が最小値の30%の状態で合計容量が130 %から120 %に減少する場合には、上記第2マップに移行して、第2の圧縮機(2) の容量が100 %から50%に減少調整されると共に、第1の圧縮機(1) の容量がインバータ(15)で70%に調整される。

よって、上記第4図の制御フローのステップS_2により、蒸発温度T_2が設定値(目標値T_{2o})になるよう、圧縮機(1),(2) の合計目標容量L_1を演算するようにした目標容量演算手段(50)を構成している。また、ステップS_3により、上記目標容量演算手段(50)の出力を受け、合計目標容量L_1に近い段階の合計容量に圧縮機(1),(2) を容量制御するようにした制御手段(51)を構成している。そして、上記制御手段(51)は、上記第2表の各圧縮機(1),(2) の容量マップを備えて、圧縮機(1),(2) の合計容量の増大時に、上記第1の圧縮機(1) の容量が最大値の100 %になった後に第2の圧縮機(2) の容量を一段増大させ、逆に、合計容量の減少時に、第1の圧縮機(1) の容量が最小値の30%になった後に第2の圧縮機(2) の容量を一段減少させるよう上記インバータ(15)とアンロード機構(2a)とを相互に関連付けて制御するようにしている。

したがって、上記実施例においては、各室内ユニット(B) ～(F) の冷房運転時、蒸発温度T_2に基いて圧縮機(1),(2) の合計目標容量L_1が目標容量演算手段(50)で演算される。そして、この目標合計容量L_1に対応する容量段になるよう、第1の圧縮機(1) の容量が制御手段(51)によりインバータ(15)で容量制御されると共に、第2の圧縮機(2) の容量が制御手段(51)によりアンロード機構(2a)で制御されて、この圧縮機(1),(2) の合計容量が上記合計目標容量L_1に精度良く調整される。その結果、冷媒の蒸発温度T_2がその目標値T_{2o}に良好に収束して、各室内が良好に冷房空調されることになる。

その場合、第2の圧縮機(2) の容量がアンロード機構(2a)で0 %と50%と100 %との間で増減調整された後は、第1の圧縮機(1) の容量が合計目標容量L_1の変化に伴いインバータ(15)で40～90%の中間値に増減調整されても、その値をそのまま保持し、最大値の100 %にならない限り一段容量は増大せず、また逆に最小値の30%にならない限り一段容量は減少されないので、アンロード機構(2a)で調整される第2の圧縮機(2) の容量を可及的長時間そのままの値に保持できて、その容量の変化回数を有効に低減することができ、第2の圧縮機(2) の耐久性，信頼性の向上を図ることができる。

尚、上記実施例では、第1の圧縮機(1) の容量をインバータ(15)で8段階に制御し、第2の圧縮機(2) の容量をアンロード機構(2a)で2段階に制御して、その合計容量を19段階に制御したが、容量の制御段数は多段階であればよい。また、第1の圧縮機(1) の最大値(100%) の状態で第2の圧縮機(2) の容量を一段増大し、第1の圧縮機(1) の最小値(30 %) の状態で一段減少制御したが、第1の圧縮機(1) の最大値近傍で一段増大し、最小値近傍で一段減少制御してもよいのは勿論である。

さらに、上記実施例では、冷房運転時を例に挙げて説明したが、暖房運転時でも同様に適用できるのは勿論のこと、マルチ型式の空気調和機に限らず、その他、1台の室外ユニットに対して1台の室内ユニットが対応する通常の空気調和機や、室内及び室外ユニットを一体化したもの等の他の冷凍装置に対しても同様に適用できるのは言うまでもない。

(発明の効果)

以上説明したように、本発明によれば、第1及び第2の圧縮機を各々インバータ及びアンロード機構で容量制御する場合、インバータ側の第1の圧縮機の容量が最大値近傍のとき、及び最小値近傍のときに限り上記アンロード機構側の第2の圧縮機の容量を増減制御したので、該第2の圧縮機の容量をそのままの値に可及的長時間のあいだ保持して、第2の圧縮機の容量変化の回数を有効に低減することができ、該第2の圧縮機の耐久性，信頼性の向上を図ることができる。

4. 図面の簡単な説明

第１図は本発明の構成を示すブロック図である。第２図ないし第４図は本発明の実施例を示し、第２図はマルチ型式の空気調和機に適用した冷媒配管系統図、第３図は第２の圧縮機の具体的な内部構成を示す図、第４図は圧縮機の容量制御を示すフローチャート図である。

(1) 第１の圧縮機、(2) …第２の圧縮機、(2a) …アンロード機構、(21)…弁体、(2n)…圧力室、(14)…冷媒配管系統、(15)…インバータ、(17)…パイロット電磁弁、(50)…目標容量演算手段、(51)…制御手段。

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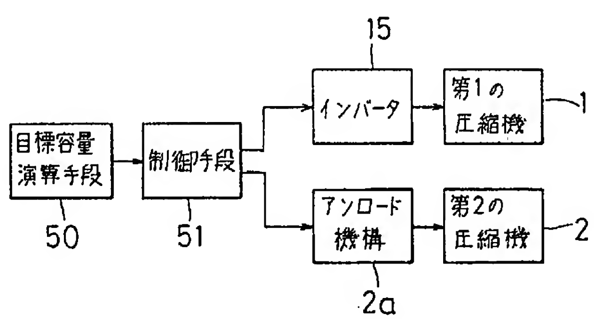
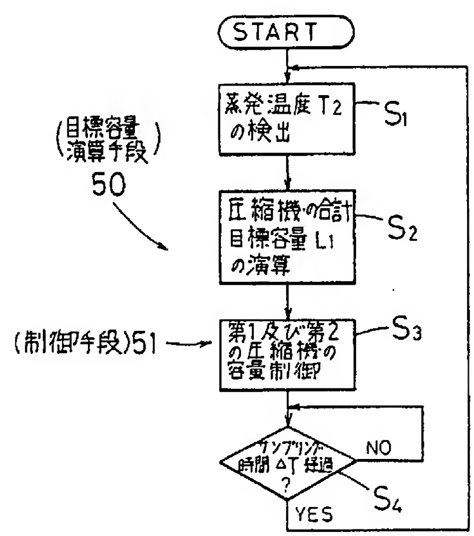
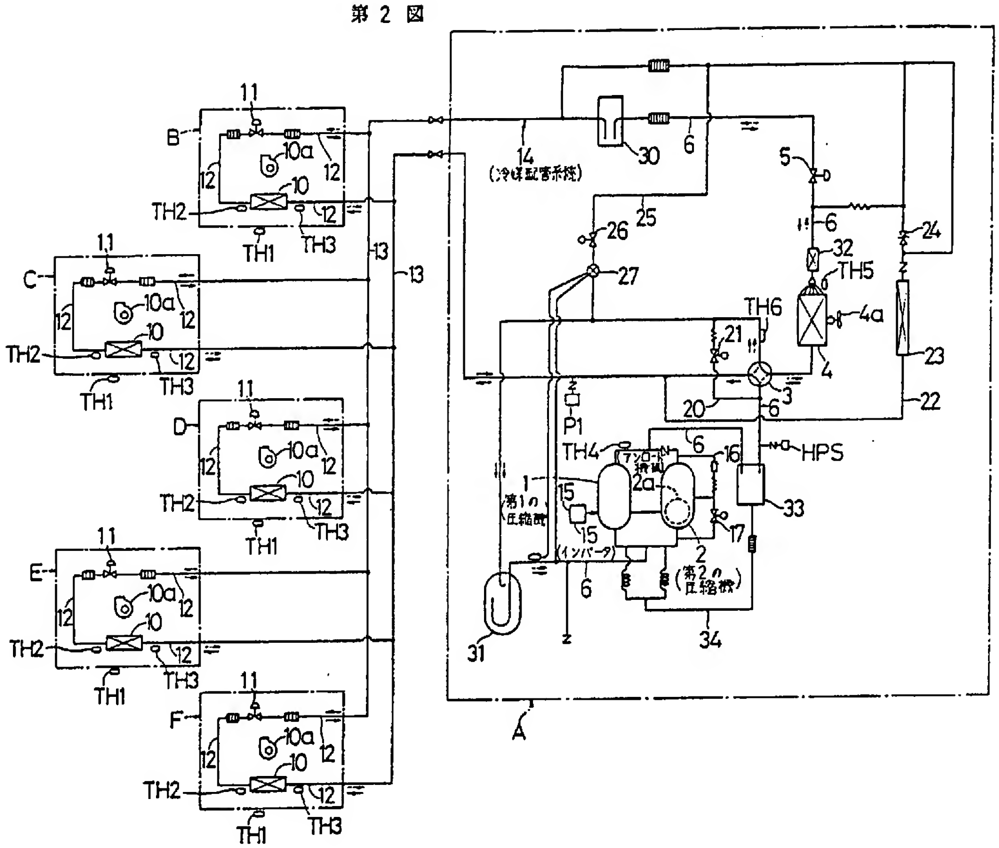
第 1 図



第 4 図

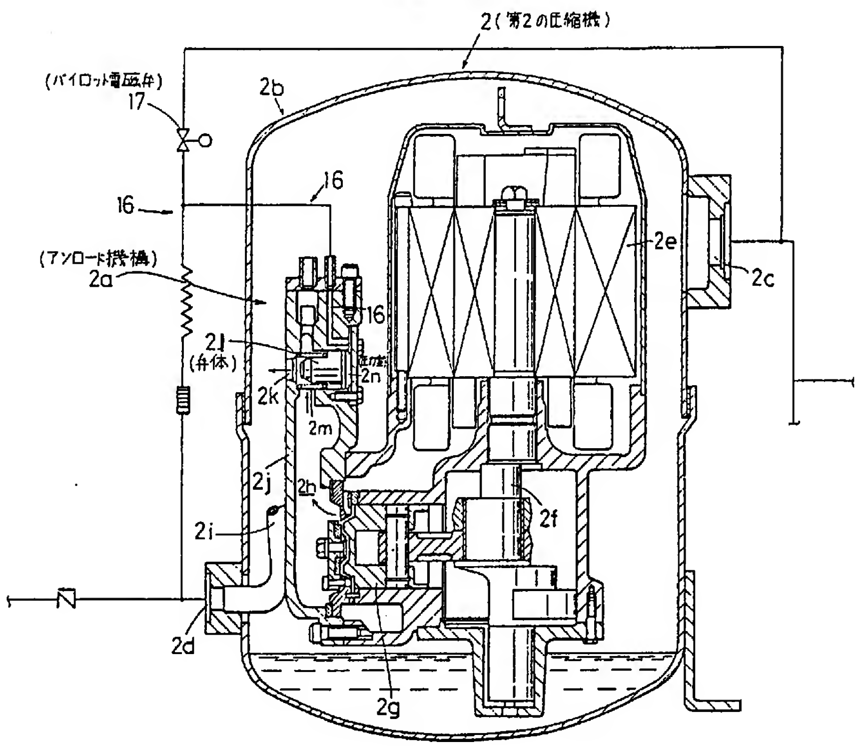


第 2 図



B
C
D
E
F
A
11
10a
10
12
13
TH1
TH2
TH3
14
(冷媒配管系統)
30
6
5
25
26
27
24
32
TH5
4a
4
23
TH6
21
3
20
22
P1
TH4
(アンロード機構)
2a
16
HPS
33
1
第1の圧縮機
15
(インバータ)
17
2
(第2の圧縮機)
34
31

第 3 図



2 (第2の圧縮機)
(パイロット電磁弁)
17
2b
16
(アンロード機構)
2a
2l
(弁体)
2k
2m
2n
2e
2c
2j
2h
2i
2f
2d
2g